

## **Virtual Planning At Work: A Tour of NASA FutureFlight Central**

Traditional airport planning uses mathematical models, demand forecasts, and computer-based simulations. Yet, operating an airport is about teams of people: air traffic controllers, pilots, and ramp operators working together to safely guide planes on and off the ground. A new state-of-the-art planning tool has recently debuted that has made it possible to assess the workloads and interactions of airport personnel who manage ever increasing air traffic.

Welcome to NASA FutureFlight Central, one of the most significant tools to date for resolving critical airport capacity problems. Located at the NASA (National Aeronautics and Space Administration) Ames Research Center, Moffett Field, California, NASA FutureFlight Central (FFC) is a world class simulation and test facility, the most advanced virtual air traffic control tower in the world. It is a two-story facility, offering a full-scale real-time simulation of any airport.

### **The Tower Cab**

When you enter the tower cab, you could be stepping into the real world of air traffic control at any one of the busiest airports in the United States. Today, the view is that of San Francisco International Airport. You encounter real controllers issuing instructions to flights that allow gate pushback, taxi, take-off, and landing clearances. You hear a controller saying, "United 267, Runway One Right, cleared for take-off, traffic off the left will turn away."

Looking out the window, the local controller watches the flight start take-off roll behind a Southwest flight departing off Runway One Left.

The ground controller transmits, "American 261, taxi to your gate."

He scans the simulated two-dimensional airport surface detection radar, observing the aircraft taxiing clear of the Runway Two Eight Left and moving towards its arrival gate. Then he sees that Flight 261 will be at its arrival gate before United Flight 2310, pushed back on the other side of American's terminal, is ready to taxi to Runway One Left.

Subsequently you hear the local controller say, "United 810 heavy, cleared to land Runway Two Eight Right, following the American Boeing 757, five miles ahead, caution wake turbulence, wind two five zero at one zero."

As he makes this transmission, he is scanning a simulated terminal radar indicator, verifying the aircraft's data block for identification, type, altitude, ground speed and landing runway.

In FutureFlight Central, controllers communicate with the aircraft using Raytheon's CommPlus System, a simulated radio and phone system. Also, they can talk to other virtual facilities such as city operations or the weather bureau via the system's dial up functions.

FutureFlight Central can simulate the staffing at the busiest of United States airport towers with up to 12 operator positions. Since the consoles are reconfigurable, any tower arrangement can be created.

Although the controllers are human beings, the 360-degree view, the airplanes and ground vehicles are computer generated. Finally, airport and airline planners can safely test the efficacy of new ground procedures, software technologies or tower configurations on the end users, the controllers, before implementation.

### **Why FutureFlight Central?**

The need for a safe testing environment prior to deployment in the real world grew out of a collaborative NASA and FAA (Federal Aviation Administration) project called Surface Movement Advisor (SMA). It was installed at Hartsfield Atlanta International Airport in 1996. SMA is an information-sharing software tool that determines flight status in real time and disseminates the information throughout the airport so that surface activity can be managed more efficiently.

Although Delta Airlines today reaps an approximate \$20 million annual saving in fuel and other Direct Aircraft Operating Costs,<sup>1</sup> prototype development and installation into a working environment had a major impact on airport operations. Controller responsibility and workload increased in an already busy airport with 2,500 daily operations.

What was needed was a place that would allow for safe testing of new technologies and procedures without impacting working operations. To maximize the benefit to all airport personnel, selected representatives of the airport community -- FAA air traffic controllers and supervisors, Air Transport Association (ATA), National Air Traffic Controllers Association (NATCA) and Hartsfield Atlanta International Airport -- participated in the design process for FutureFlight Central. Three design reviews, Preliminary, Critical and Final were completed, resulting in the most modern simulator of its type in the world.

### **The Ground Level**

Returning to the ground floor, you will walk by the heartbeat of the facility, SGI's Onyx2, a super-computer capable of processing three-dimensional graphics for depicting up to 200 moving aircraft and ground vehicles simultaneously in real time. SGI's system, equipped with six graphics pipes, 16 processors, and two gigabytes of dynamic memory, sends the digitized visual data to the 12 projectors located behind the windows in the tower cab. Each projector, capable of 2000 X 2000 resolution, transmits its image onto a mirror which in turn reflects its image onto one of the twelve giant screens.

### **The Pilot Room**

---

<sup>1</sup> Rada, Wilma: *Surface Movement Advisor (SMA) Benefit Analysis*. Prepared by FAA/ASD and MCA Research Corporation, October 14, 1997.

Next door, our tour takes us to the Pilot room, where the facility can staff a maximum of 13 "pseudo-pilot" positions. Using Adacel Technologies (Canada) interface software, pseudo-pilots "fly" the virtual airplanes, according to the verbal instructions they receive from the controllers in the tower cab. Each pseudo-pilot handles up to fifteen moving three-dimensional models at a time.

In this room we hear a pseudo-pilot say, "San Francisco Ground, this is United 2079, Gate 80, ready for push back." Upon receiving approval from the controller, the pseudo-pilot enters the push back command into his computer and then scans the two-dimensional simulated airport map to make sure the aircraft is moving out of the gate.

Another pseudo-pilot transmits, "San Francisco Tower, American 59 heavy, seven out for Runway Two Eight Right." After he has received the landing clearance from the controller upstairs, he enters the command in his computer.

A third pseudo-pilot requests, "San Francisco Tower, this is FAA 31, request permission to cross Runway Two Eight Left at Taxiway Echo." As the pseudo pilot receives approval, he enters the command into the computer and the vehicle crosses the runway.

As in a real airport operation, the pseudo-pilots communicate with the air traffic controllers using headsets and the radio system. Raytheon's CommPlus software can be configured to support all radio frequencies including "party line" communications operating at an airport.

### **The Ramp Tower and Airport Operations**

The next room is the ramp tower and airport operations room, where a full up ramp tower operation is in progress. Ramp tower controllers provide gate pushback and arrival instruction to flights operating in designated airport ramp areas. The ramp tower controllers are looking at computer screens displaying the ramp areas under their control.

A ramp tower controller directs, "United 2215, push back from Gate 70 approved, plan Spot One for departure." The ramp controller enters the command into the computer and scans the two-dimensional simulated airport map to verify the flight is starting movement from the gate.

Another ramp controller transmits, "United 1125, taxi to Spot Two, contact San Francisco Ground on one two one point nine."

Still another informs, "United 3780, expect push back in twenty minutes due to flow control to Los Angeles."

This room also has an area set aside for an airport operations center where emergency situations can be simulated.

### **The Test Engineers Room**

Lastly, you will enter the Test Engineer's Room, the operating center of the facility. You will see three people at work: the test engineer, principal investigator, and audio/visual engineer.

The test engineer has the ability to command and control the dynamics of the simulation environment, including initiation, monitoring, suspension and test coordination. He can insert any unusual situation or condition such as an emergency or changing weather to test responses in the air traffic control system. The principal investigator, working with the test engineer, monitors the progress of the simulation. Various "exercises" or configurations of aircraft arrivals and departures can be run.

Next to the test engineer, is the audio/visual engineer who monitors the recordings of the scenarios. Using the latest state-of-the-art equipment, the audio-visual engineer can record all simulation data elements: environment data, static and dynamic aircraft data, button presses, key-in, voice and data communications. Recorded data also is used for statistical analysis, and the facility can output data in a format compatible with COTS relational database format.

Customer audio-visual recordings are edited using the facility's advanced multimedia presentation capabilities. Video footage, still images, charts and overlay text, audio signals or narration can be combined to produce a broadcast quality video, for communicating results to all stakeholders.

### **Summary**

In conclusion, FutureFlight Central will permit integration of tomorrow's technologies in a risk-free simulation of any airport, airfield, and tower cab environment. The facility provides an opportunity for airlines to mitigate passenger delays by fine tuning airport hub operations, gate management and ramp movement procedures. It also allows airport managers an opportunity to study effects of various improvements at their airports. Finally, it enables air traffic controllers to provide feedback and to become familiar with new airport operations and technologies before final installation.